A NATIONAL PROGRAM OF RESEARCH

FOR SOYBEANS

Prepared by a Joint Task Force
as recommended by the
Agricultural Research Planning Committee
of the U. S. Department of Agriculture and the
State Universities and Land Grant Colleges

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PREFACE

Soybean Research Needs through 1977

Authority: The Joint Task Force on Soybean Research was appointed in memoranda of Dr. G. L. Mehren, Assistant Secretary of Agriculture, dated March 24, 1967, and Dr. R. L. Lovvorn, Chairman, Experiment Station Committee on Organization and Policy, dated March 29, 1967.

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Assignment: Soybean research in Research Problem Areas 207, 208, 209, 307, 308, 309, 405, 406, 407, 408, 501, and 504 was assigned to the Task Force.

Within the general framework of the Long-Range Study, the Task Force was instructed to indicate areas of research which need emphasis and to determine the most efficient procedures for organizing and carrying out the specific research involved.

The Task Force recognizes the merit of the close association which has existed between USDA and SAES workers and recommends that this relationship be continued as the research program expands. This expansion, at least initially, should be by the development of teams of scientists at

selected locations rather than by wide dispersion. The Task Force is very concerned with the problem of obtaining adequate trained manpower to carry out the recommendations. Concentration at selected locations would help assure maximum utilization of the anticipated scarce manpower resources for the research job already upon us. The USDA and the SAES should keep this in mind in allocating the funds appropriated for this program.

Some assumptions were necessary in estimating the value of present production and potential benefits of research. The Task Force adopted as basic the following data: Acreage, 40 million (approximate 1967 acreage); yield, 25 bushels per acre (1966 average); value, $2.50 per bushel (current support price).

It is recognized that benefits to be derived in RPAs 207, 208, and 209 will be due to recovery or prevention of losses or saving in cost of control. The maximum benefit in these areas at current production and price levels is the value of present losses and control costs. Benefits from other RPAs will be due to increased efficiency leading to more production, to improved and therefore more valuable products, and the development of new products. The maximum benefit in these areas is indefinite. In some cases the benefits are intangible, for example, the benefits of improving the food supply of those who are inadequately fed or suffer from malnutrition cannot be expressed readily in dollars.

Situation: The spectacular increase in soybean production has been due largely to increased acreage. Much of the increased acreage became available for soybean production as a result of policies which limited or discouraged production of other major crops.

Policies and attitudes concerning production of various crops are changing. To a greater extent than in the past, the farmer will compare the potential profit of a soybean crop with that of some other crop or enterprise. Soybeans probably will not maintain their present 40 million-acre and billion-bushel production level unless unit production costs are lowered. This may be achieved by more efficient production practices and/or increased yields.

It is important to the national welfare and to the food needs of a hungry world that a high level of soybean production be maintained. Soybean protein is a major resource in the fight against hunger. Because of the high protein content and excellent protein balance of soybeans, increases in soybean yields are immediately effective in improving the world protein situation. For example, an increase of only one bushel per acre in soybean yields on 40 million acres would increase protein supplies by 480,000 tons. This is quantitatively equivalent to the entire protein needs of 17 million people. As a supplement to other sources of protein, it would benefit a vastly larger number.

It is, therefore, the judgment of the Task Force that the most urgent problem facing soybean research workers is the need for increased yield per acre.

Current research effort by State and Federal agencies (1966 inventory) in RPAs related to protection and production (207, 208, 209, 307, 308, 309 405) is approximately 89 SMY. Of these, 64% are SAES and 36% are Federal. They are widely dispersed. SAES effort exists in thirty-one states. No state has more than 5.2 SMY on soybean production research and most of the thirty-one have less than 2 SMY. ARS effort is located in fourteen states, two having more than 5 SMY and four having less than 2 SMY. Historically, the national soybean production research program has developed on a regional basis, stemming from the original authorization in the Bankhead-Jones Act of the mid-1930s. The Federal effort has been and is oriented primarily toward regional objectives. Federal personnel have been stationed in groups in areas where soybean production was expected to become most important. SAES research has increased rapidly in recent years as soybean production has expanded and as local problems have intensified.

Research objectives in the past have of necessity emphasized regional problems, solution of which would be beneficial over a wide region. This emphasis, wisely established by State and Federal leaders more than thirty years ago, and the concomitant cooperative regional research effort of State and Federal workers, have been of great value in conducting an efficient research program with limited resources. This emphasis on problems of general concern and close cooperation among research workers in all agencies should be continued.

At the same time, it is recognized that soybean production is now beset with problems which must be solved in the context of local production conditions. Many problems involve conditions or interactions which, if not unique, are at least inadequately represented by regional averages. Such problems will increase as soybean production is intensified, and especially as production is extended into new areas and onto new soils.

> Recommendation 1: The Task Force recommends protection and production research effort be distributed in 24 specific objectives within the production RPAs. We expect that the recommended research will produce the technology necessary to raise the national average yield from 25 to 40 bushels per acre. At present acreage and price levels, this would increase farm income $1.5 billion per year by 1977, or an annual increase of $150 million. Research effort should be increased from 89 to 200 SMY by 1972 and to 246 SMY by 1977. Our recommendations are similar to those of the Joint Committee (JC) referred to in the table of SMYs on page 7 and the original recommendation in the Long Range Study (LRS), except that we recommend a larger proportion of the increase in RPA 307 and smaller proportions in RPAs 208 and 405 than JC and less in RPA 405 than LRS. We recommend a rapid increase in research in these areas. The major part of the increase should be sought by 1972 because of the urgency of world food problems. Special thought to soybeans should be given to TF 20, water and watersheds, in its consideration of RPA 105, conservation and efficient use of water for agriculture.

Utilization and marketing research has provided products and markets for most of the soybeans or soybean products produced. Research in these areas should be continued. Surpluses of oil have occurred in the past and are predicted for the future. There is a need for increased emphasis on research related to edible and industrial oil products. There is a need for increased emphasis on research to identify and eliminate constituents which detract from the quality of soybean products. There is need for research to develop new food products which will facilitate use of soybeans in the diets of developing nations. Increased marketing research is needed to insure orderly movement of soybeans and soybean products into the channels of domestic and foreign trade.

Current research effort by State and Federal agencies (1966 inventory) in Research Problem Areas related to Utilization and Marketing (406, 407, 408, 501, 504) is approximately 42 SMY. Of these, 12% are SAES and 88% are Federal.

> Recommendation 2: The Task Force recommends research effort be distributed in seven specific objectives within the utilization and marketing RPAs. We recommend somewhat larger increases in RPAs 406 and 407 related to food and feed products than JC and LRS. We also recommend a larger proportion of the increase be sought by 1972 because of the urgency of world food problems. The Northern Utilization Research and Development Division should continue its role as the principle location of utilization research. Expansion of utilization research in SAES should make maximum use of present competence.

SUMMARY OF INVENTORY, RECOMMENDATIONS, BENEFITS

Research Problem Area	1966[1] Inventory	1972 JC Recom[2] SAES	1972 JC Recom[2] USDA	1972 TF Recom	1977 JC Recom[2] SAES	1977 JC Recom[2] USDA	1977 TF Recom	1977 LRS Recom
207 Control of Insect Pests	7	10	4	17	15	6	20	22
208 Control of Diseases	22	17	19	36	27	25	44	42
209 Control of Weeds, etc.	11	14	6	29	18	8	30	30
Subtotal - Protection	40	41	29	82	60	39	94	94
307 Biological Efficiency	42	53	11	101	103	20	145	139
308 Mechanization[3]	-	-	-	3	-	-	3	2
309 Systems Analysis	0	1	2	4	2	3	4	4
405 Consumer Acceptability	7	3	8	10	6	10	10	16
Subtotal - Production	49	57	21	118	111	33	162	161
406 Food Products	23	3	25	38	4	36	44	41
407 Feed and Non-food Products	11	0	12	21	0	16	24	18
Subtotal - Utilization	34	3	37	59	4	52	68	59
408 Market Quality	3	1	3	4	2	4	6	6
501 Grades & Standards[3]	-	-	-	1	-	-	1	0
504 Market Efficiency	5	2	3	5	2	4	6	2
Subtotal - Marketing	8	3	6	10	6	6	13	8
Grand Total	131	104	93	269	179	132	337	322

1/ Inventory of Agricultural Research, Vol. I, Table I, June 1967.

2/ A joint committee representing the Experiment Station Committee on Organization and Policy, and the USDA, met in Chicago on July 21-22, 1967, to review manpower allocations and recommended the SMYs shown. The abbreviation (JC) is used for Joint Committee.

3/ No allocation by Commodities in Inventory or JC Recommendation.

TITLE: Noninsecticidal and integrated methods of controlling insects. RPA 207-A.

SITUATION: Public opposition to the use of insecticides continues to become more intense. Use of insecticides may lead to residues in the seed or in the processed oil. Some insecticides are harmful to wildlife or upset the balance of beneficial organisms, including pollinating insects. Many insects have become resistant to insecticides that formerly gave effective control. There are unlimited opportunities for the development of noninsecticidal and integrated control methods. Effective control of insects attacking other crops has been attained by integrating use of biological, autocidal, and attractant methods with use of resistant varieties. Little effort has been made to use these methods for the control of soybean insects.

OBJECTIVE: To develop soybean varieties resistant to insects, and determine the chemical, physiological, or morphological nature of resistance; to determine the effectiveness of parasites, predators, and diseases for the control of major soybean insects; develop techniques for their establishment, maintenance, and dispersion; to investigate the use of chemical and physical attractants and cultural methods for soybean insect control; and to develop integrated control programs including minimum use of insecticides for soybean insects.

RESEARCH APPROACHES:

A. Collect and evaluate soybean germ plasm for insect resistance.

B. Transfer resistant germ plasm to adapted varieties.

C. Determine the chemical, physiological, or morphological nature of resistance and the inheritance of these factors.

D. Conduct studies on soybean insect parasites, predators, and disease producing pathogens; develop techniques for quantity production and make tests designed to evaluate these organisms for field control.

E. Conduct tests to determine if the major soybean insects can be sterilized with radiation or chemosterilants, and determine if the sterile male release technique can be used for area-wide control.

F. Isolate sex attractants from major soybean insects and conduct field tests on the feasibility of controlling these insects by the use of these or other attractants.

G. Combine these various techniques into integrated insect control systems suitable for use by soybean growers.

CHARACTER OF POTENTIAL BENEFITS: Reduce cost of production and increase yield and quality.

MAGNITUDE OF POTENTIAL BENEFITS: Insects cause an estimated $75 million loss to soybeans each year, and an additional $12 million is spent on control. An estimated 4 million acres of soybeans are treated with insecticides each year. If effective noninsecticidal and integrated control methods could be developed, it should be possible to reduce this loss by $50 million and also to reduce residue hazards.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
5	6

TITLE: Biology of insects attacking soybeans. RPA 207-B.

SITUATION: Most insects that attack soybeans are native pests that fed on other crops or weeds before soybeans were extensively grown. There is evidence that some of these pests now prefer soybeans to their original host. The decline in acreage of cotton and other crops and increase in soybean acreage has and will continue to cause a change in pest population. The impact of this crop change should be studied to determine its effect upon present pest populations and potential new pests. The biology of most insects that feed on soybeans has been determined on other host plants but has not been adequately determined on soybeans.

OBJECTIVE: To determine the occurrence, distribution, abundance, habits, nutritional requirements, and other biological and ecological characteristics of insects attacking soybeans, and utilize this information for the development of chemical, cultural, biological, and other methods for their control.

RESEARCH APPROACHES:

A. Determine the seasonal habits (including mating, feeding, and migration), preference for alternate host plants, and population dynamics of major soybean insects and from this information establish life tables for different ecological areas. All possible sampling methods would be used including mark-release-recapture techniques, light traps, suction machines, sweep nets, directional wind traps, sticky-board traps, pitfall traps, soil washing, and soil sifting equipment .

B. Determine the effect of various insect populations at different times and under different growing conditions on yield and quality of soybeans, and determine the economic injury thresholds.

C. Evaluate the impact of changes in crop sequence and production practices on pest populations and potential new pests.

D. Coordinate research on a regional basis to assure complementarity of related programs.

CHARACTER OF POTENTIAL BENEFITS: Reduce the cost of production by more efficient use of insect control measures. Reduce residue hazards.

MAGNITUDE OF POTENTIAL BENEFITS: This benefit is included in that given for 207-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
8	8

TITLE: Insecticidal methods of controlling insects. RPA 207-C.

SITUATION: Insecticides are the first line of defense against insects. Many insects, including some that attack soybeans, have become resistant to insecticides that formerly gave satisfactory control. A continual need for new insecticides to control infestations or sudden outbreaks of insects will exist for the foreseeable future. Recent information has shown that oilseed plants such as the soybean translocate chlorinated hydrocarbon insecticides to the seeds. Soybeans may contain residues of insecticides used on soybeans or on other crops in the rotation. There are no tolerances in soybeans for some insecticides approved for other crops. U.S. tolerances may not be accepted internationally. This is especially critical in soybeans because of the large export market. Some insecticides are phytotoxic to some varieties of soybeans. Some insecticides reduce the population of beneficial parasites and predators and may kill wildlife. New insecticides must be evaluated as they become available to assure their safe use for the intended purpose, and to identify possible undesirable effects.

OBJECTIVE: To develop cheaper and more effective insecticidal control methods that will leave no objectionable residues in soybeans, cause minimum reduction to beneficial insects, and be nonhazardous to higher animals.

RESEARCH APPROACHES:

A. Evaluate new insecticides for soybean insect control in the laboratory and field.

B. Test various insecticide formulations, rates, and times of application using different types of ground and aerial equipment.

C. Evaluate the effect of insecticides on beneficial insects and wildlife, and for phytoxicity to different soybean varieties.

D. Determine insecticide residues at harvest in the seed, oil, meal, and forage.

CHARACTER OF POTENTIAL BENEFITS: Elimination or reduction of insect and residue problems.

MAGNITUDE OF POTENTIAL BENEFITS: Safer and more effective use of insecticides would reduce residue hazards to health of man and animals, and would lower the cost of control. This benefit is included in that given for 207-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
4	6

TITLE: Control of diseases through genetics and breeding. RPA 208-A.

SITUATION: Plant pathogens which attack soybeans increase the hazards of production. Bacterial pustule may reduce yields of susceptible varieties by 8 to 15 percent. Measurable yield reductions from target spot have been obtained with susceptible varieties in 60 percent of the years. These yield reductions have been as high as 50 percent. Phytophthora rot can completely destroy a crop. Brown stem rot is widely distributed. The cyst nematode can cause yield reductions of 50 to 100 percent and root-knot nematodes may cause severe injury. Genetic resistance has been identified for some serious soybean diseases but not for others.

OBJECTIVE: To identify sources of resistance to plant pathogens, determine the mode of inheritance, and transfer this resistance to productive, well-adapted varieties.

RESEARCH APPROACHES:

A. Observe available germ plasm for reaction to pathogens.

B. Study inheritance of host reaction to pathogens.

C. Conduct breeding programs to transfer resistance to productive, well-adapted varieties.

CHARACTER OF POTENTIAL BENEFITS: Hazards of production will be reduced, seed yields increased, and seed quality improved.

MAGNITUDE OF POTENTIAL BENEFITS: Diseases cause an estimated loss of $250 million per year. At least $75 million of this loss might be saved through use of resistant varieties.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
16	20

TITLE: Crop sequences and management practices to reduce incidence of soybean diseases. RPA 208-B.

SITUATION: Continuous cropping is known to increase the injury to soybeans resulting from cyst nematodes and brown stem rot. Crop rotation aids in control of these diseases. However, rotation with cotton increases the severity of injury from target spot and root-knot nematode. Crop sequence appears to have little influence upon injury from phytophthora rot. Certain weed species are believed to be carriers of viruses which infect soybeans. Methods of tillage and sanitation are effective in controlling certain diseases on other crops. Chemical control measures are of minor significance.

OBJECTIVE: To study disease development on soybeans under different crop sequence systems, methods of tillage, and weed control programs, and to develop management practices to reduce losses due to diseases.

RESEARCH APPROACHES:

A. Study effects of one or more plant pathogens with different crop sequence patterns and methods of seedbed preparation.

B. Determine alternate crops and weeds which may serve as hosts for soybean pathogens.

C. Study the effect of various cropping procedures and management practices on the soil microorganism balance in relation to soilborne pathogens.

D. Test chemical agents for systemic or localized control of diseases and develop techniques for the effective use of such agents.

CHARACTER OF POTENTIAL BENEFITS: Determination of the significance of changing crop sequence patterns on soybean diseases; evidence of advantages and disadvantages of monoculture on certain soil types; identification of other plant species which may be significant in prevalence of soybean diseases.

MAGNITUDE OF POTENTIAL BENEFITS: Approximately $50 million of the annual soybean disease losses may be saved by development of proper management practices.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
5	8

TITLE: The role of insects in transmission of soybean viruses. RPA 208-C.

SITUATION: Several virus diseases such as soybean mosaic, bean pod mottle virus, tobacco ring spot virus, and yellow mosaic occur in soybeans. Soybean mosaic and bean pod mottle viruses when present together cause significant yield losses. Tobacco ring spot virus has caused complete loss through failure of seed set in localized areas. Undoubtedly, other viruses occur but have not been investigated. Insects are by far the most important agents of virus transmission. Soybean mosaic is transmitted by aphids, and bean pod mottle virus is spread by bean leaf beetle. Leafhoppers are suspected as a transmitter of tobacco ring spot virus but no vector has been positively identified. Since insects are important in transmission of virus, investigations to better understand their role in the transmission and spread of soybean viruses should be expanded.

OBJECTIVE: To determine the role of mites and insects in the transmission of soybean diseases and use this information as an aid to control the disease.

RESEARCH APPROACHES:

A. Use various mites and insects, especially aphids and leafhoppers, collected in virus-infected soybean fields, in transmission tests to determine if they are vectors of soybean viruses.

B. Determine virus movement and increase within the vector.

C. Determine the relationship of vector movement between and within fields to the spread and incidence of viruses.

D. Exclude certain suspected vectors from areas within fields of soybeans having virus problems to observe virus development and spread in the absence of insects and the effect of vector control on the incidence and spread of viruses.

CHARACTER OF POTENTIAL BENEFITS: Reduced yield losses from virus diseases; improved seed quality.

MAGNITUDE OF POTENTIAL BENEFITS: Potential yield increase 10 million bushels, valued at $25 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
2	2

TITLE: Etiology of soybean diseases. RPA 208-D

SITUATION: Numerous plant pathogens are known to attack soybeans. Estimates of yield reductions have been made for bacterial pustule, target spot, cyst nematodes, and phytophthora rot. Yield reductions may range from slight to complete destruction. Additional pathogens are frequently recognized but estimates of yield reduction have not been made. Pathogens frequently appear in combination. The interrelationships are not fully understood. Information on life histories of pathogens as they relate to soybean diseases is essential for an efficient control program.

OBJECTIVE: To gain a more thorough understanding of pathogens attacking soybeans and their effects upon the efficiency of the soybean plant.

RESEARCH APPROACHES:

A. Identify pathogens and determine host range and environmental factors favoring their development.

B. Study life cycles of pathogens.

C. Use closely related resistant and susceptible soybean strains or chemical control to determine extent of injury caused by pathogens.

D. Study genetic and environmental variability of pathogens.

E. Study interrelationships of two or more pathogens.

F. Develop effective inoculation techniques to facilitate studies of injury and control methods.

CHARACTER OF POTENTIAL BENEFITS: The benefits from this activity are related directly to those from breeding and management. The information obtained will facilitate and speed the gains obtained in the other activities and may prevent losses that would occur in the absence of the information.

MAGNITUDE OF POTENTIAL BENEFITS: The magnitude of potential benefits cannot be quantified specifically and is included in 208-A and 208-B.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
12	12

TITLE: Identification and control of foreign diseases that may damage soybeans. RPA 208-E.

SITUATION: Many of the plant pathogens known to attack soybeans in Asia have not been identified in U. S. soybean-growing areas. The reaction of U. S. germ plasm to some of these pathogens is not known.

OBJECTIVE: To determine reaction of major U. S. soybean varieties and germ plasm to foreign disease organisms and to better understand the potential damage that could result from introduction of such soybean pathogens.

RESEARCH APPROACHES:

A. Screen U. S. varieties for reaction to pathogens in areas where diseases are now found.

B. Study nature of disease and its incitant in areas where it is a problem.

C. Initiate breeding program, in cooperation with foreign scientists, to develop resistant lines for U. S. areas where disease is most likely to be a problem.

D. Participate in the International Biological Program in order to obtain maximum effectiveness of international programs.

CHARACTER OF POTENTIAL BENEFITS: Minimize effects upon U. S. soybean production if pathogen is introduced.

MAGNITUDE OF POTENTIAL BENEFITS: Understanding a disease such as soybean rust and having resistant genotypes identified prior to introduction of the pathogen could prevent losses due to new diseases. It is not possible to quantify the magnitude of the benefit of protection against new diseases. However, a devastating disease such as a rust could cause losses of hundreds of millions of dollars per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
1	2

TITLE: Principles and practices to control specific weeds in soybeans. RPA 209-A.

SITUATION: The weed flora in soybeans differs not only from area to area, but may differ from farm to farm. A weed control program for one soybean grower may not be suitable for his neighbor because of different weed species, different soils, different crops, and different equipment availability. More effective weed control could be achieved with better information on control of specific weeds as it is affected by cropping practices, cultural practices, and crop-chemical interactions.

OBJECTIVE: To determine the most adequate system of cultural, biological, and chemical control practices for specific weeds in soybeans.

RESEARCH APPROACHES:

A. Study cropping sequences to determine the effect of various practices on the weed population.

B. Develop combinations of cropping sequence, herbicides, and cultural practices for specific weed situations.

C. Exploit the results of research described in RPA 209-B, -C, -D, -E, and -F, which is essential for achievement of the objective of this RPA.

D. Coordinate with research in RPAs 307 and 308.

CHARACTER OF POTENTIAL BENEFITS: Increase soybean yields by reducing weed competition. Make available to the soybean grower information needed to select the best weed control system for his specific situation.

MAGNITUDE OF POTENTIAL BENEFITS: Weed losses are estimated at $400 million per year. The benefits of research in 209-A, -B, -C, -D, -E, and -F will be realized through 209-A. An estimated $300 million of present losses could be saved annually by research in RPA 209.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
3	4

TITLE: Mechanism of action of soybean herbicides. RPA 209-B.

SITUATION: Soybean herbicides have been developed from rather massive screening programs in chemical companies. Better herbicides are needed for soybeans. Present pre-emergence compounds fail about one-third of the time thus allowing weeds to compete with soybeans. Herbicides sometimes injure soybeans. Post-emergence herbicides are generally unsuited for soybeans. A better understanding of the mechanism of herbicide action would facilitate development of new and better herbicides.

OBJECTIVE: To determine the mode of action of soybean herbicides and to use this information in developing new chemicals and improving old ones.

RESEARCH APPROACHES:

A. Determine the effects of soybean herbicides on various metabolic systems in weed and crop plants.

B. Develop and test theories, based on results of A, to explain herbicide action and selectivity.

C. Use information from A and B to design and search for new and more effective weed control compounds.

CHARACTER OF POTENTIAL BENEFITS: Synthesis of safer and more effective soybean herbicides. A satisfactory post-emergence chemical could eliminate weed control failures due to weather and reduce the cost of weed control.

MAGNITUDE OF POTENTIAL BENEFITS: Magnitude of potential benefits is included in 209-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
6	6

TITLE: Application techniques to improve herbicide performance in soybeans. RPA 209-C.

SITUATION: A rather large group of promising herbicides are not used in soybeans because suitable application techniques are lacking. Some of these materials are volatile, and hence may disappear too rapidly or may affect nearby sensitive crops. Some are nonselective and may damage soybeans, but might be useful if applied as directed post-emergence sprays or pre-plant treatments. In addition new incorporation techniques may improve the performance of presently used chemicals.

OBJECTIVE: To improve weed control in soybeans by studies on various chemical application techniques.

RESEARCH APPROACHES:

A. Determine the most effective means of applying volatile and nonvolatile weed control chemicals (incorporation at planting, injection devices, preplant incorporated treatments, etc.) This would include a study of chemical additives for drift control.

B. Develop application techniques for nonselective chemicals in soybeans, to include evaluation of preplant treatments and various directional devices to maximize weed control and minimize soybean injury.

C. Coordinate with research in RPAs 307 and 308.

CHARACTER OF POTENTIAL BENEFITS: Improved weed control practices for soybeans by increased efficiency from present weed chemicals; development of techniques to make available new soybean herbicides from chemicals presently used for other purposes.

MAGNITUDE OF POTENTIAL BENEFITS: Magnitude of potential benefit is included in 209-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
5	5

TITLE: Life history of specific weeds common to soybean fields. RPA 209-D.

SITUATION: There has been very little study of the physiology, anatomy, and morphology of most weed species. Thorough study of the life cycle of annual and perennial weeds may reveal stages of growth at which chemical or cultural control would be most effective. The ultimate weed control practice is one which would lead to the destruction of weed seeds in the soil. Studies of seed dormancy and methods of breaking dormancy could lead to better control of the seeds in the soil.

OBJECTIVE: To determine stages in the life cycles of annual and perennial weeds where control measures would be most effective.

RESEARCH APPROACHES:

A. Determine the growth patterns and relative competitiveness of weeds in relation to soybeans from germination to maturity.

B. Determine physiological and anatomical characteristics of specific weeds and evaluate these characteristics as means of controlling weed growth.

C. Study the nature and extent of weed seed dormancy in various species and develop methods to alter dormancy. Particular emphasis would be placed on the time and extent of germination in relation to soil temperatures.

CHARACTER OF POTENTIAL BENEFITS: Better timing of cultural weed practices or chemical treatments; more effective use of weed control measures through control of dormancy of weed seeds.

MAGNITUDE OF POTENTIAL BENEFITS: Magnitude of potential benefits is included in 209-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION

1972	1977
4	4

TITLE: Herbicide specificity, selectivity, and interaction with other chemicals in relation to soybean production. RPA 209-E.

SITUATION: During the past 20 years a large number of chemicals have become available for weed control. Many of these have not been critically evaluated for minimum levels of toxicity to individual weed species nor for tolerance by soybeans. Many herbicides are used without adequate information on specificity of the herbicide. Some soybean growers are using fungicides and insecticides in addition to herbicides. The interaction of these materials needs to be studied.

OBJECTIVE: To determine minimum effective and toxic levels of herbicides and develop combinations of pesticides for more efficient weed control.

RESEARCH APPROACHES:

A. Determine the minimum rate of specific herbicides needed to kill individual weeds in soybeans.

B. Determine the effect of herbicide, insecticide, and fungicide combinations on pest control and soybean growth.

C. Develop combinations of chemicals for broader spectrum weed control in soybeans and better soybean tolerance to herbicides.

CHARACTER OF POTENTIAL BENEFITS: Lower yield losses in soybeans caused by weeds, improved performance of herbicides, and better information on which soybean growers may base their selection of herbicides and other pesticides.

MAGNITUDE OF POTENTIAL BENEFITS: Magnitude of potential benefits is included in 209-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
6	6

TITLE: Soil and plant residue effects in relation to soybean production. RPA 209-F.

SITUATION: A number of useful herbicides leave soil residues that may affect soybeans. The fate of herbicides in soils and soybeans needs to be determined to prevent injury to the soybean plant and contamination of the environment.

OBJECTIVE: To determine the fate of herbicides applied to the soil for weed control in soybeans and other crops and to identify potential hazards to soybean production.

RESEARCH APPROACHES:

A. Analyze soil and plant materials to determine levels of herbicide residues under different environmental conditions.

B. Determine chemical derivative residues of herbicides in soils or plant materials.

C. Determine toxicity of derivative residues.

CHARACTER OF POTENTIAL BENEFITS: Prevention of losses due to stand loss and plant injury to soybeans and other crops planted on fields previously treated with herbicides; reduced possibility of contaminating crop products.

MAGNITUDE OF POTENTIAL BENEFIT: Magnitude of potential benefits is included in 209-A.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
5	5

TITLE: Plant characteristics and management practices. RPA 307-A.

SITUATION: Soybean genotypes apparently differ in efficiency of water use, especially when water supply is limited. Strains of similar growth type and maturity may produce comparable yields with adequate moisture, but significantly different yields under conditions of drouth stress. Dates and rates of planting, row width, rotation sequences, growth habit, and other factors interact with the environment in influencing productivity. It may be possible to develop strains which can utilize greater quantities of water to produce higher seed yield. Deeper root penetration may enable the soybean plant to utilize soil moisture more fully and to tolerate periods of drouth stress better. Seedbed preparation and planting rates and dates, may influence stand establishment. These factors and irrigation may also influence efficiency of water use.

OBJECTIVE: To determine the attributes which permit soybeans to make most efficient use of water in producing maximum seed yields; to correlate total water use with water use efficiency under various conditions; to identify management practices which will result in more uniform stands, deeper root penetration, and maximum response from irrigation water.

RESEARCH APPROACHES:

A. Evaluate time of planting, methods of planting, and methods of seedbed preparation in relation to crop productivity and the ability of plants to utilize available water or respond to application of water.

B. Evaluate plant characteristics to identify those which contribute to most efficient water use in producing high seed yields at different levels of water availability.

C. Evaluate plant characteristics to determine those which increase tolerance to extremes--excesses or deficiencies of water--yet permit the plant to produce high seed yields.

D. Evaluate strains under various moisture levels and soil types to determine if those which produce well at low moisture levels are most efficient in water use at all levels.

E. Coordinate with weed studies in 209-A, fertility, nitrogen, and root studies in 307-B, -D, and -E, and engineering studies in 308.

CHARACTER OF POTENTIAL BENEFITS: Hazards of production will be reduced and higher yields of good quality seed obtained.

MAGNITUDE OF POTENTIAL BENEFITS: More efficient water use could result in an average yield increase of 1 bushel per acre, valued at $100 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
8	12

We recommend that TF 20, Water and Watersheds, give special thought to soybeans in its consideration of RPA 105, conservation and efficient use of water for agriculture.

TITLE: Nutrient relationships and fertilization of soybeans. RPA 307-B.

SITUATION: The failure of direct soybean fertilization to consistently increase yields is one of the major factors limiting soybean production today. Yield increases can be expected from the application of phosphorus and potassium when availability of these nutrients in the soil is low, but failure to obtain a response at medium or high soil fertility levels is common. Soybeans respond to micronutrients on some soils, but areas of deficiencies are not well identified. A pH of 5.8 to 6.5 is desirable for soybean production. Liming changes the pH of the surface soil but has little influence on the subsoil pH. As a result, aluminum toxicity may limit root development in highly acid subsoils, and thus contribute to drouth stress, reduced nutrient uptake, and lower yields.

OBJECTIVE: To understand the mineral nutrition of soybeans so that response to direct fertilization can be assured; to determine whether macro- or micro-nutrients are limiting seed yields under conditions considered to be optimum for seed development; to determine the effects of low pH subsoil upon root development and water and nutrient uptake, and if detrimental to the plant, develop corrective methods.

RESEARCH APPROACHES:

A. Determine nutrient concentrations in the total plant and plant parts which define and separate deficiency, adequacy, and luxury levels of essential nutrients at different growth stages.

B. Obtain specific information on: (1) nutrient interactions that influence plant growth and final yield, (2) nutrient uptake rates at various stages of growth, (3) translocation of nutrients within the plant, and (4) genetic variability in expression of these factors.

C. Study the influence of acid subsoils on root penetration and nutrient and water uptake under varying moisture situations, at different surface soil pH levels, and with soybean genotypes differing in sensitivity to aluminum.

D. Coordinate with water, nitrogen, and root studies in 307-A, -D, and -E, and engineering studies in 308.

CHARACTER OF POTENTIAL BENEFITS: Increased soybean yields through greater responses to fertilization and development of methods for estimating nutrient requirements at specific stages of growth.

MAGNITUDE OF POTENTIAL BENEFITS: An average yield increase of 1 bushel per acre, valued at $100 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
14	19

TITLE: More efficient energy storage by soybeans. RPA 307-C.

SITUATION: The major problem in soybeans is low yields. Photosynthesis in single leaves is saturated by a light intensity about one-third that of full sunlight. The closed canopy in soybean fields lowers light intensities on some leaves to as little as 100 foot candles. At this intensity, the rate of photosynthesis hardly exceeds that of respiration. Furthermore, soybeans have a photo-respiration mechanism capable of oxidizing unproductively a substantial portion of the organic carbon produced in photosynthesis. It is not known whether changes in these or other anatomical and metabolic characteristics of soybeans could contribute significantly to improvement in effeciency of energy storage and yield.

Present techniques for studies of photosynthesis, lipid metabolism, protein synthesis, translocation, and other aspects of plant metabolism, and for measurement of light and carbon dioxide, are adequate for detailed studies of the significance of these processes to soybean yields.

OBJECTIVE: To identify genotypes combining improved energy storage with other desirable attributes and develop management practices which will increase the conversion of absorbed light energy to chemical energy and the storage of energy in the seed.

RESEARCH APPROACHES:

A. Determine the significance of variability in anatomical details due to genetic or environmental causes to the absorption of carbon dioxide, the conversion of light energy to chemical energy, and the storage of energy in soybean seed.

B. Identify details of photosynthesis and related processes which may contribute to a more efficient energy storage.

C. Determine the total energy demands of metabolic systems synthesizing fat and protein, and evaluate the significance of these demands to total energy storage.

D. Determine the genetic variability of significant anatomical, metabolic, or other factors.

E. Develop management practices to provide maximum absorption of carbon dioxide and light.

CHARACTER OF POTENTIAL BENEFITS: Increased soybean yields.

MAGNITUDE OF POTENTIAL BENEFITS: An average yield increase of 0.5 bushel per acre, valued at $50 million per year. In addition, most of the benefit from this research will be realized through Genetics and Breeding, RPA 307-F.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
10	12

TITLE: Nitrogen nutrition. RPA 307-D.

SITUATION: Soybean yields from very high levels of nitrogen fertilization have not exceeded those obtained with good nodulation. Very little information is available relative to growth promoting substances other than nitrogen that might be produced in the nodule. One strain of Rhizobium japonicum is known to produce a chlorosis-inducing toxin. Present information is not sufficient to permit productive manipulation of the nitrogen nutrition of soybeans by fertilization as can be done with many other crops.

OBJECTIVE: To develop methods of increasing nitrogen utilization by the soybean plant so as to obtain higher seed yield.

RESEARCH APPROACHES:

A. Ascertain the maximum yield possible with nitrogen from nodulation and whether soybean yields are limited by inadequate nitrogen from nodulation.

B. Characterize nitrogen fixation in the nodule and the metabolic steps required to convert fertilizer or fixed nitrogen to forms stored in the plant.

C. Ascertain the variability among strains of nodulating bacteria in efficiency of nitrogen fixation and the significance of interactions among genotypes of bacteria and genotypes of soybeans.

D. Develop inoculation procedures that will permit improved strains of bacteria to be introduced into the soil and utilized by the plant in preference to indigenous strains.

E. Ascertain the relationships of strains of bacteria with other microorganisms in the soil in relation to survival of strains of rhizobia.

F. Coordinate with water, fertility, and root studies in 307-A, -B, and -E, and the engineering studies in 308.

CHARACTER OF POTENTIAL BENEFITS: Increased yields.

MAGNITUDE OF POTENTIAL BENEFITS: An increase of 1 bushel per acre, valued at $100 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
10	11

TITLE: Root-soil relationships. RPA 307-E.

SITUATION: Soybean yields obtained by good managers often vary 20 to 40 percent between fields on the same farm. This variability is assumed to be due primarily to conditions existing below the soil surface.

Such attributes of the soil as soil moisture, air, temperature, mechanical impedance, and microbial activity influence root and plant development. Vegetative growth and seed production of the soybean plant are affected by the distribution and function of the roots. Microbial activities are presumably intense in the zone encompassing the root system and are not necessarily identical with those occurring in soil more remote from the roots. The biochemical activities of the rhizosphere population have not been sufficiently defined for evaluation of effect on seed production. The effect of root exudates on soil microorganisms and on the uptake and translocation of nutrients is poorly understood.

Since optimum soil properties are not known, modification of soil factors for maximum soybean seed production must be determined empirically.

OBJECTIVE: To determine means of improving the soybean root system and root environment to increase efficiency in water and nutrient uptake.

RESEARCH APPROACHES:

A. Characterize soybean root growth, development, and function under various conditions.

B. Determine optimum soil-water conditions for soybean root development.

C. Determine if there are genetic differences in total root growth affecting seed yield.

D. Determine if nutrient uptake is directly correlated with the formation of new root structure.

E. Determine if a longer period of root development will contribute to higher seed yield.

F. Investigate microbial activities in the rhizosphere and the role of root exudates.

G. Coordinate with water, fertility, and nitrogen studies in 307-A, -B, and -D, and the engineering studies in 308.

CHARACTER OF POTENTIAL BENEFITS: More efficient use of water, nutrients, and oxygen; increased seed yield.

MAGNITUDE OF POTENTIAL BENEFITS: Benefits from this research will be realized through better water and nutrient utilization and are included in estimates for 307-A, -B, and -D.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
11	17

TITLE: Genetics and breeding for higher yield. RPA 307-F.

SITUATION: The success of soybean production in the United States can be attributed largely to use of improved varieties resulting from genetics and breeding research. Much more can be accomplished in this field. Research has barely begun on the genetic analysis of numerous traits ranging from gross morphology, such as determinate vs. indeterminate growth, to physiological responses, energy storage, and water or nutrient use. Complete utilization of information on basic physiological processes to improve seed yield and seed quality depend in large part on research in genetics and breeding.

OBJECTIVE: To develop through breeding higher yielding soybeans which have desired market qualities.

RESEARCH APPROACHES:

A. Ascertain the inheritance of basic physiological differences as information on the processes is accumulated.

B. Explore the extent that the soybean may be modified genetically to improve its efficiency in the utilization of light, water, carbon dioxide, and nutrients for producing seed.

C. Investigate the interactions between genotypes of the soybean and genotypes of nodulating bacteria to determine the extent that improved combinations can be developed and utilized.

D. Investigate the influence of protein and oil content and of amino and fatty acid balance on seed yield, and incorporate the desired qualities into productive varieties.

E. Develop more efficient genetic combinations with multiple disease resistance, tolerance to pesticides, and responsiveness and efficiency in utilization of water, light, and nutrients.

F. Investigate methods of breeding; identify ways to increase gain per breeding cycle and reduce the time for each cycle.

CHARACTER OF POTENTIAL BENEFITS: Improvement in genetic potential for yield. Development of types varying in protein and oil relationship could result in expanded usage. Productive varieties with improved oil and/or protein quality would increase value of oil and protein.

MAGNITUDE OF POTENTIAL BENEFITS: An increase of 4 bushels per acre, valued at $400 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
40	64

TITLE: Growth regulators for soybeans. RPA 307-G.

SITUATION: Growth regulating chemicals have been approved for a few specific uses in crop production. More will be available in the future. These chemicals may stimulate plant growth or control plant behavior in ways that make crops better suited to needs. The influence of a limited number of growth regulators on floral development in soybeans has been investigated and at lease one promising lead has occurred. However, the influence of many existing growth regulating substances on soybeans has not been investigated.

OBJECTIVE: To find growth regulators that will consistently increase yields and be economically feasible for use in soybean production.

RESEARCH APPROACHES:

A. Screen chemicals to identify compounds which can increase soybean yields.

B. Determine concentration limits of growth regulators through studies of rates and methods of application.

C. Determine the significance of wetting properties of solutions, nature of leaf surfaces, drying conditions, degree of coverage, and physiological status of the plant on the effectiveness of a foliar application.

D. Investigate the possibility of supplying growth regulators to the plant through a soil application.

E. Conduct basic metabolic studies to identify reactions or systems which might be modified with growth regulators to increase yield.

CHARACTER OF POTENTIAL BENEFITS: Increase soybean yields and possibly extend area of adaptation.

MAGNITUDE OF POTENTIAL BENEFITS: An increase in average yield of 0.2 bushel per acre valued at $20 million.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
8	10

JTF Soybean Research

TITLE: Mechanization of soybean production. RPA 308.

SITUATION: Machinery used in soybean production is hard to operate with maximum effectiveness. Machinery problems sometimes cause farmers to plant soybeans too deep or at undesirable rates. Equipment for cultivation or herbicide application frequently damages the crop. Combines cause field losses up to 15 percent, plus major damage such as broken or cracked beans. Adjustments in equipment are imprecise and hard to make. Continuous adjustment may be needed due to uneven terrain or variability in soil characteristics.

OBJECTIVE: To develop equipment principles which will make it possible to reduce planting and harvesting costs, and to reduce the number of operations required in soybean production.

RESEARCH APPROACHES:

A. Investigate alternative means of controlling planting depth and rates to insure optimum seed placement.

B. Continue efforts to reduce numbers of operations required to produce the soybean crop; adapt or develop equipment for better application of herbicides.

C. Develop sensors to scan the crop ahead of planting and harvesting mechanisms to signal and control machine adjustments.

D. Improve components of harvesting mechanisms to permit more efficient entry of plant into machine, automated adjustment, and higher quality threshing and separating.

E. Coordinate with research in 209-A, 307-A, -B, -D, and -E.

CHARACTER OF POTENTIAL BENEFITS: Lower unit production costs, maintain quality.

MAGNITUDE OF POTENTIAL BENEFITS: Much of the benefit of mechanization research will be realized through better weed control, fertilization, and water use practices. In addition to benefits in other RPAs, savings due to lower seed requirements and reduced harvest losses are valued at $30 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
3	3

TITLE: Systems analysis for soybean production. RPA 309.

SITUATION: Soybean producers must choose among many alternatives for selection of varieties, planting times, row spacing, plant populations, size and capacity of machinery, and time and amount of fertilizer, irrigation, and weed control practices. The proper selection from these alternatives would provide for optimum use of labor, capital, and machine capacity as influenced by weather probabilities, field condition, and time. Mathematical models are needed to simulate the variables and alternatives in the production system in order to compare the profitability of various alternatives.

OBJECTIVE: To combine that set of production practices, capital investments, and labor availability that will optimize income from soybean production on individual farms.

RESEARCH APPROACHES:

A. Adapt or develop and use mathematical models for simulating the soybean production system to identify factors requiring additional research.

B. Test hypothetical systems of utilizing all known resources to produce maximum yields. Simulated differences in varieties, nutrients, water, herbicides, and other elements of management practice will be compared to determine most productive and economical combinations.

CHARACTER OF POTENTIAL BENEFITS: Reduced unit production costs.

MAGNITUDE OF POTENTIAL BENEFITS: Insufficient data are available to estimate potential benefits. Systems analysis for soybeans should be a part of more broadly based analyses for entire farm enterprises including several crops and livestock. The more varied the enterprise, the greater are potential benefits from systems analysis. Benefits will be realized in many areas due to more effective use of management resources.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
4	4

TITLE: Production of soybeans with improved quality. RPA 405.

SITUATION: Quality problems in soybeans relate to total oil and protein content, amino acids, fatty acids, flavor stability, and constituents of significance in phenomena such as flatus. Except for total oil and protein, progress in producing soybeans with increased processing or product quality is limited by lack of knowledge as to the cause of poor quality or the identity of significant constituents, or by analytical methodology which in some cases is inadequate to support a breeding program.

OBJECTIVE: To develop varieties or practices to produce soybeans of improved processing quality, nutritive value, or flavor stability; to increase oil and protein at the expense of carbohydrates; and to develop suitable techniques for measurement of chemical constituents or other factors which may be critical in processing or in the use of soybean products.

RESEARCH APPROACHES:

A. Identify genotypes containing significant chemical constituents in higher or lower than normal concentrations and use such genotypes to breed agronomically superior varieties with superior composition.

B. Determine the significance of environmental factors during crop production on the levels of chemical constituents of special significance in processing quality, consumer acceptability, animal nutrition, and flavor stability.

C. Devise new or modified analytical techniques appropriate to support Approaches A and B.

CHARACTER OF POTENTIAL BENEFITS: Increased supply of highly nutritious food.

MAGNITUDE OF POTENTIAL BENEFITS: Improved protein balance, elimination of linolenic acid, and elimination of factors causing flatus and other undesirable effects would result in increased value and savings in processing costs estimated at $100 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
10	10

TITLE: New and improved soybean protein food products. RPA 406-A.

SITUATION: Soybean protein products have high nutritional value, as is shown by their extensive use in livestock and poultry feed. Comparatively little use is made of soybeans in the human diet. Low-cost foods that are highly nutritious and dietarily attractive are needed not only in the United States but throughout the world. Their formulation and use must be based on available commodities, nutritional requirements, and consumer acceptability. Many inexpensive soybean food products need improvement for consumer acceptability. Improvements in flavor, physiological activity, and texture are needed to achieve greater use and consumer acceptance. Procedures now available probably make it feasible to identify flatus and flavor precursors.

OBJECTIVE: To obtain greater consumer acceptance of soybean protein food products.

RESEARCH APPROACHES:

A. Identify flatus and flavor precursors in soybeans.

B. Investigate enzymatic methods of removing or modifying undesirable factors.

C. Determine the relationship of composition and structure of soybean protein products and their combinations with cereal products to the nutritional and physiological responses of humans.

D. Cooperate with industry in A, B, and C, and in evaluating procedures developed in this research.

CHARACTER OF POTENTIAL BENEFIT: Soybean protein products, such as full-fat or defatted soy flour represent the lowest priced source of high quality protein for human consumption. At least 1.5 to 2 billion people do not have enough to eat. The potential of these products to meet food needs in the United States and the world is enormous. Without low-cost procedures to improve acceptability of these products, this potential is not likely to be achieved.

MAGNITUDE OF POTENTIAL BENEFIT: Average daily per capita consumption of protein in the United States is estimated as 65 grams. If soy flour were to replace half of the animal protein in the diet of the low income group, a saving of $1 billion per year would be realized.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
20	26

TITLE: Oil stability. RPA 406-B.

SITUATION: Soybean oil is the major food fat in the United States, but its use in both foreign and domestic markets can be increased by improvements in its flavor stability. Important areas where additional improvement is desirable are primarily in the liquid oil, including use as a cooking and salad oil, and as an ingredient of solid or semisolid products. Although linolenate is known to be a major factor in the flavor problem of soybean oil, other components appear to be secondary factors and their identity and effects must be determined. Surpluses of oil over domestic needs have averaged over one billion pounds during the last 8 years. Increased production of soybeans, greater meal use, and a decline in hard currency markets for oil will increase supplies. Increased research is needed to make improved edible products available in all markets.

OBJECTIVE: To devise methods of chemically treating soybean oil to provide a more stable oil for use in cooking and salad oil and as a liquid ingredient of margarine.

RESEARCH APPROACHES:

A. Develop superior catalytic and chemical methods to stabilize soybean oil from the effects of linolenate esters. Better methods will be sought to hydrogenate selectively the linolenate esters to compounds more resistant to oxidative deterioration. Studies on a large scale will be conducted in cooperation with industry to determine the practicality of laboratory developments.

B. Devise superior methods of determining flavor stability.

C. Identify volatile flavor products other than linolenate derivatives.

CHARACTER OF POTENTIAL BENEFITS: More extensive domestic and foreign use of soybean oil as a cooking and salad oil and as an ingredient of soft margarine and shortenings.

MAGNITUDE OF POTENTIAL BENEFITS: Expanded use in the United States and retention and expansion of export markets represent a potential benefit of $60 million per year. Current domestic consumption of soybean oil is about 5 billion pounds per year, 90 percent of which is for food uses. Improved oil quality is estimated to be worth $0.01 per pound of oil, or about $60 million increase in value of oil used domestically for food.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
18	18

TITLE: New and improved industrial products from soybean oil. RPA 407-A.

SITUATION: About 10 percent of total domestic disappearance of soybean oil, or 500 million pounds. goes into nonfood uses. About 100 million pounds goes into resins and plastics, 100 million pounds into paints and varnishes, and the rest into other uses including chemicals, special lubricants, and soaps. Utilization research has resulted in the development of markets for epoxidized soybean oil, Additional opportunities exist because the total usage of synthetic organic chemicals, coatings, and related materials is increasing. Soybean oil has found use in these nonfood products because it is a high volume low-cost material. Increased stocks of oil will result from greater production of soybeans, larger use of meal, and a decline in hard currency markets for oil Competitive nonfood products will help stabilize price and increase outlets in domestic and foreign markets.

OBJECTIVE: To increase nonfood uses of soybean oil by chemical modification; to produce new or improved products or chemical intermediates; to evaluate new materials in various applications.

RESEARCH APPROACHES:

A. Develop and test new plastics, resins, coatings, and other new and improved nonfood products or processes.

B. Evaluate new products and processes for specific uses.

C. Adapt procedures for chemical modification of promising products to continuous low-cost processing.

CHARACTER OF POTENTIAL BENEFITS: New outlets for soybean oil in nonfood uses should increase the total farm income. Such outlets help stabilize prices by diversification of markets.

MAGNITUDE OF POTENTIAL BENEFITS: Outlets for industrial organic chemicals in plastics, agricultural chemicals, and related industries totaled more than 10 billion pounds in 1964. Previous successes with dimer acids, polyamide resins, and epoxidized soybean oil have shown that soybean oil can share in these increasing outlets for chemicals. One percent of this total industrial market would use 100 million pounds of soybean oil, with a value of about $30 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
11	11

TITLE: Improved feed use of soybean meal. RPA 407-B.

SITUATION: The composition of soybean meal is known to vary but the extent of variation is not known. Specific data on significant feed constituents is essential if maximum benefit is to be received from computer-control of feed formulation. Laboratory methods are now available for determination of key ingredients such as minerals and amino acids. More rapid analytical methods are needed for computer-control of feed formulation to achieve optimum use of soybean meal.

OBJECTIVE. To obtain new information on, and develop rapid methods for, the analysis of soybean meal for key feed ingredients.

RESEARCH APPROACHES:

A. Analyze soybean meal of several varieties produced at several locations and by several processes to determine the effect of genetic, location, and processing variables on the value of meal for feed purposes.

B. Develop analytical methods that are rapid and simple enough to be used in feed formulation.

CHARACTER OF POTENTIAL BENEFITS: Nutrient economies based on actual composition of soybean meal will permit more efficient production of swine and poultry.

MAGNITUDE OF POTENTIAL BENEFITS: The value of any saving in formulation will be reflected in the gross income or farm value of products. In the $7.3 billion swine and poultry industry, a 1 percent improvement in overall efficency effected by improved nutrient economies would be worth about $73 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
10	13

TITLE: Quality maintenance of soybeans and their products during marketing. RPA 408.

SITUATION: Soybeans and their products are subject to deterioration in quality with resultant economic loss between the time of harvest and ultimate use. Information is needed on the effect and control of temperature, humidity, and atmosphere in storage. Methods are needed to detect chemical residues and other quality deteriorating factors.

There is need for detection and control of insects during storage and marketing.

In order for grades and standards to be useful in buying and selling by description and to have economic differentials based on varying levels of quality, rapid and accurate objective measures of quality attributes are needed.

OBJECTIVE: To determine optimum environmental conditions for soybeans and their products during the marketing process.

RESEARCH APPROACHES:

A. Develop techniques, instruments, and procedures for detecting and measuring chemical residues, presence of insects, and other contaminants affecting quality.

B. Develop practical and objective methods of determining quality attributes.

CHARACTER OF POTENTIAL BENEFITS: Reduction in quality and product loss during marketing. The results of this research should facilitate marketing transactions through more accurate description of products and more previse measurement of quality attributes.

MAGNITUDE OF POTENTIAL BENEFITS: A benefit of 1 percent of the farm value of soybeans would amount to $25 million annually.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
4	6

TITLE: Improvement of grades and standards. RPA 501.

SITUATION: Grades and standards in the marketing system should provide meaningful communication with respect to quality of a product in relation to its price. Objective, quick, and accurate measures for characteristics of economic significance are needed, along with increasing automation in the use of this information. Most soybeans are traded in the U.S. on the basis of official grades, which are determined by test weight per bushel, moisture, splits, damaged kernels, and foreign materials. Oil and protein content are not factors in the grading system. The producer of high oil or high protein soybeans is underpaid and the producer of soybeans with inferior composition is overpaid. Low cost and accurate methods of testing for oil and protein at country buying points are not now available. A system of grades recognizing oil and protein content would require such methods. Provision for research to develop such methods is included in RPA 407-B.

OBJECTIVE: To provide grades and standards that will effectively communicate value differences for varying gradations of quality.

RESEARCH APPROACHES:

A. Evaluate the effectiveness of existing grade standards in serving the needs of sellers and buyers and for reflecting different gradations of quality which affect value and use.

B. Determine the need for grade standards for the many new soybean products and those to be developed in the future for which grade standards do not exist.

C. Develop descriptive terminology for grade standards which will characterize the different attributes of soybeans and their products so as to facilitate communication between buyers and sellers.

D. Establish a uniform system of grades recognizing those characteristics which reflect value and affect use.

CHARACTER OF POTENTIAL BENEFITS: Improved communication through more precise terminology for describing varying gradations of quality. Prices would more accurately reflect value.

MAGNITUDE OF POTENTIAL BENEFITS: Insufficient data are available to estimate potential benefits. An exploratory investigation is needed to appraise the potential gain from a major research effort on this problem.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
1	1

TITLE: Physical and economic efficiency in marketing. RPA 504.

SITUATION: Recent expansion of soybean production has been accompanied by shifts in centers of production. Patterns of national and international demands are changing. Processing technology, the structure of transportation rates, and other economic factors affecting costs may interact to foster marketing inefficiencies in the soybean industry. Adjustments may be needed in the location, size, and number of processing plants because of changes in production areas and demand patterns.

OBJECTIVE: To obtain information necessary for establishment of an effective but flexible marketing system that can operate at optimum efficiency under everchanging conditions.

RESEARCH APPROACHES:

A. Determine the most efficient and economical system for handling, transporting, storing, and distributing soybeans, including the type, size, and location of facilities.

B. Evaluate the overall structure and performance of soybean markets including studies of prices and marketing costs, margins, practices, and services.

C. Evaluate the economic impacts of marketing innovations, new or improved products and market development activities on soybeans and their products in both domestic and foreign markets.

CHARACTER OF POTENTIAL BENEFITS: Reduce the total cost of producing, processing, and distributing the national soybean crop and thereby save resources for increasing real national income.

MAGNITUDE OF POTENTIAL BENEFITS: Insufficient data are available for estimating potential benefits. A saving in marketing costs of 1 percent of the farm value would amount of $25 million per year.

RECOMMENDED RESEARCH EFFORT:

TF RECOMMENDATION	
1972	1977
5	6

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